

WHAT IS CLAIMED IS:

1. A fuel injection valve comprising:

a needle valve including a base material;

an opposite member including a base material whose sliding

5 section is in slidable contact with a sliding section of the base material of the needle valve in presence of fuel for an automotive vehicle; and

a hard carbon thin film coated on at least one of the sliding sections of the base materials of the needle valve and the opposite

10 member, the hard carbon thin film having a surface hardness ranging from 1500 to 4500 kg/mm² in Knoop hardness, a film thickness ranging from 0.3 to 2.0 μm, and a surface roughness (Ry) (μm) which satisfies a relationship represented by the following formula (A):

$$Ry < (0.75 - Hk/8000) \times h + 0.0875 \dots (A)$$

15 where h is the thickness (μm) of the hard carbon thin film; and Hk is the surface hardness in Knoop hardness (kg/mm²) of the hard carbon thin film.

2. A fuel injection valve as claimed in Claim 1, wherein the fuel for an automotive vehicle contains at least one additive selected from the

20 group consisting of an ester-based additive and an amine-based additive.

3. A fuel injection valve as claimed in Claim 2, wherein the at least one additive is at least one additive selected from the group consisting of octane booster, cetane booster, antioxidant, metal deactivator,

25 detergent-dispersant, deicing agent, and corrosion inhibitor.

4. A fuel injection valve as claimed in Claim 1, wherein the hard carbon thin film contains hydrogen atom in an amount of not more than 0.5 atomic %.

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5. A fuel injection valve as claimed in Claim 1, wherein the hard

carbon thin film is a diamond-like carbon thin film.

6. A fuel injection valve as claimed in Claim 5, wherein the diamond-like carbon film is formed by an arc ion plating process.

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7. A fuel injection valve as claimed in Claim 1, wherein the at least one of the sliding sections of the base materials of the needle valve and the opposite member has a surface roughness (Ra) of not more than 0.03 μm in a condition before the at least one of the sliding sections is coated with the hard carbon thin film.

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